FORMAT 1

Submit original with signatures + 1 copy + electronic copy to Faculty Senate (Box 7500).
See http://www.uaf.edu/uafgov/faculty-senate/curriculum/course-degree-procedures-/ for a complete description of the rules governing curriculum & course changes.

NEW COURSE PROPOSAL

SUBMITTED BY:

Department	Computer Science	**College/School**	CEM
Prepared by	Dr. Orion Lawlor	**Phone**	451-1708
Email Contact	lawlor@alaska.edu	**Faculty Contact**	Dr. Orion Lawlor

1. ACTION DESIRED (CHECK ONE): Trial Course [ ] New Course [X]

2. COURSE IDENTIFICATION: Dept: CS | Course #: 482 | No. of Credits: 3

Justify upper/lower division status & number of credits: A technically sophisticated, programming-heavy graphics elective lecture course that meets 3 hours per week.

3. PROPOSED COURSE TITLE: Simulations in Computer Graphics

4. To be CROSS LISTED? *YES/NO* — No | If yes, Dept: | Course #:

NOTE: Cross-listing requires approval of both departments and deans involved. Add lines at end of form for additional required signatures.

5. To be STACKED? *YES/NO* — No | If yes, Dept. | Course #:

How will the two course levels differ from each other? How will each be taught at the appropriate level?:

Stacked course applications are reviewed by the (Undergraduate) Curricular Review Committee and by the Graduate Academic and Advising Committee. Creating two different syllabi—undergraduate and graduate versions—will help emphasize the different qualities of what are supposed to be two different courses. The committees will determine: 1) whether the two versions are sufficiently different (i.e. is there undergraduate and graduate level content being offered); 2) are undergraduates being overtaxed?; 3) are graduate students being undertaxed? In this context, the committees are looking out for the interests of the students taking the course. Typically, if either committee has qualms, they both do. More info online – see URL at top of this page.

6. FREQUENCY OF OFFERING: Spring odd-numbered years.

Fall, Spring, Summer (Every, or Even-numbered Years, or Odd-numbered Years) — or As Demand Warrants

7. SEMESTER & YEAR OF FIRST OFFERING (AY2013-14 if approved by 3/1/2013; otherwise AY2014-15): Spring 2015

8. COURSE FORMAT:

NOTE: Course hours may not be compressed into fewer than three days per credit. Any course compressed into fewer than six weeks must be approved by the college or school's curriculum council. Furthermore, **any core course compressed to less than six weeks must be approved by the Core Review Committee.**

COURSE FORMAT: (check all that apply) [ ] *1* [ ] *2* [ ] *3* [ ] *4* [ ] *5* [X] *6 weeks to full semester*

OTHER FORMAT (specify)

Mode of delivery (specify lecture, field trips, labs, etc): **Lecture, paper and electronic homeworks, computer lab work, online machine problems.**

9. CONTACT HOURS PER WEEK: [3] LECTURE hours/weeks [ ] LAB hours /week [ ] PRACTICUM hours /week

Note: # of credits are based on contact hours. 800 minutes of lecture=1 credit. 2400 minutes of lab in a science course=1 credit. 1600 minutes in non-science lab=1 credit. 2400-4800 minutes of practicum=1 credit. 2400-8000 minutes of internship=1 credit. This must match with the syllabus. See http://www.uaf.edu/uafgov/faculty-senate/curriculum/course-degree-procedures-/guidelines-for-computing-/ for more information on number of credits.

OTHER HOURS (specify type)

10. COMPLETE CATALOG DESCRIPTION including dept., number, title, credits, credit distribution, cross-listings and/or stacking (50 words or less if possible):

Example of a complete description:

FISH F487 W, O Fisheries Management
3 Credits Offered Spring
Theory and practice of fisheries management, with an emphasis on strategies utilized for the management of freshwater and marine fisheries. *Prerequisites: COMM F131X or COMM F141X; ENGL F111X; ENGL F211X or ENGL F213X; ENGL F414; FISH F425; or permission of instructor.* Cross-listed with NRM F487. (3+0)

CS 482 Simulations in Computer Graphics
3 Credits Offered Spring Odd-Numbered Years
Software to simulate physical phenomena for use in interactive visualization, such as particle systems, Navier-Stokes fluid dynamics, and finite element solid mechanics. Includes Lagrangian and Eulerian meshes, stability, and discretization order. Our focus is high performance qualitatively correct simulations, rather than high-precision solutions. *Prerequisites: CS 381 and PHYS 212.* (3+0)

11. COURSE CLASSIFICATIONS: Undergraduate courses only. Consult with CLA Curriculum Council to apply S or H classification appropriately; otherwise leave fields blank.

H = Humanities [ ] S = Social Sciences [ ]

Will this course be used to fulfill a requirement for the baccalaureate core? **If YES, attach form.** **YES:** [ ] **NO:** [ ]

IF YES, check which core requirements it could be used to fulfill:

O = Oral Intensive, **Format 6** [ ] W = Writing Intensive, **Format 7** [ ] X = Baccalaureate Core [ ]

11.A Is course content related to northern, arctic or circumpolar studies? If yes, a "snowflake" symbol will be added in the printed Catalog, and flagged in Banner.

YES [ ] NO [ ]

12. COURSE REPEATABILITY:

Is this course repeatable for credit? YES [ ] NO [X]

Justification: Indicate why the course can be repeated (for example, the course follows a different theme each time).

How many times may the course be repeated for credit? [ ] TIMES

If the course can be repeated for credit, what is the maximum number of credit hours that may be earned for this course? [ ] CREDITS

If the course can be repeated with variable credit, what is the maximum number of credit hours that may be earned for this course? [ ] CREDITS

13. GRADING SYSTEM: Specify only one. Note: Changing the grading system for a course later on constitutes a Major Course Change - Format 2 form.

LETTER: [X] PASS/FAIL: [ ]

RESTRICTIONS ON ENROLLMENT (if any)

14. PREREQUISITES

CS 381 (Computer Graphics) and PHYS 212 (General Physics).

These will be *required* before the student is allowed to enroll in the course.

15. SPECIAL RESTRICTIONS, CONDITIONS

16. PROPOSED COURSE FEES

$

Has a memo been submitted through your dean to the Provost for fee approval? Yes/No [ ]

17. PREVIOUS HISTORY

Has the course been offered as special topics or trial course previously? Yes/No [Y]

If yes, give semester, year, course #, etc.:

Spring 2009: CS 480
Spring 2011: CS 493
Spring 2013: CS 493

18. ESTIMATED IMPACT

WHAT IMPACT, IF ANY, WILL THIS HAVE ON BUDGET, FACILITIES/SPACE, FACULTY, ETC.

Existing computer science student lab is adequate, and the visualization lab space is adequate.
The faculty member who previously taught CS 481 every year will now teach CS 482 in odd years.

19. LIBRARY COLLECTIONS

Have you contacted the library collection development officer (kljensen@alaska.edu, 474-6695) with regard to the adequacy of library/media collections, equipment, and services available for the proposed course? If so, give date of contact and resolution. If not, explain why not.

No [ ] Yes [Y] **2010-08-10: Existing collections are adequate**

20. IMPACTS ON PROGRAMS/DEPTS

What programs/departments will be affected by this proposed action?
Include information on the Programs/Departments contacted (e.g., email, memo)

Impacts should be contained to the UAF CS undergraduate and graduate programs.

21. POSITIVE AND NEGATIVE IMPACTS

*Please specify **positive and negative** impacts on other courses, programs and departments resulting from the proposed action.*

Positive impacts: students have a new option for an elective, CS 482.
Negative impacts: in a year where 482 is taught, students may have preferred 481, and vice versa. Instructor cannot reuse course material from CS481 every year.

JUSTIFICATION FOR ACTION REQUESTED

The purpose of the department and campus-wide curriculum committees is to scrutinize course change and new course applications to make sure that the quality of UAF education is not lowered as a result of the proposed change. Please address this in your response. This section needs to be self-explanatory. Use as much space as needed to fully justify the proposed course.

Computer graphics is a diverse and growing field, and our current two-elective package of CS 381, an introduction to graphics; and CS 481, Topics in Computer Graphics; is becoming inadequate to cover the material in sufficient depth. This course essentially allows us to split CS 481 into a more rendering-focused portion keeping the original number, and the new course CS 482 to cover the expanding field of visual simulations. One graphics elective will still be offered every semester, with CS 381 every fall, and CS 481 and 482 alternating in the spring.

As an upper-division computer science elective course, few other departments should be affected. Computer science has the eventual goal of allowing students to choose an elective package leading to a degree specialization in either computer graphics or computer security.

We previously taught this course as CS 480 in 2009, and CS 493 in 2011 and 2013. The permanent number, CS 482, will be used from 2015 onward.

APPROVALS: Add additional signature lines as needed.

See attached	Date	9/4/13	
Signature, Chair, Program/Department of:			
Chun-Jen Lin	Date	9/27/2013	
Signature, Chair, College/School Curriculum Council for:			
Chad E Mayer	Date	9/30/13	
Signature, Dean, College/School of:	CEM		

Offerings above the level of approved programs must be approved in advance by the Provost.

	Date	

Signature of Provost (if above level of approved programs)

ALL SIGNATURES MUST BE OBTAINED PRIOR TO SUBMISSION TO THE GOVERNANCE OFFICE

	Date	

Signature, Chair
Faculty Senate Review Committee: ___Curriculum Review ___GAAC

___Core Review ___SADAC

ADDITIONAL SIGNATURES: (As needed for cross-listing and/or stacking)

	Date	
Signature, Chair, Program/Department of:		
	Date	
Signature, Chair, College/School Curriculum Council for:		
	Date	
Signature, Dean, College/School of:		

ATTACH COMPLETE SYLLABUS (as part of this application). This list is online at:
http://www.uaf.edu/uafgov/faculty-senate/curriculum/course-degree-procedures-/uaf-syllabus-requirements/

APPROVALS: Add additional signature lines as needed.

Tom Cuddy | Date 9/4/13
Signature, Chair, Program/Department of:

Date
Signature, Chair, College/School Curriculum Council for:

Date
Signature, Dean, College/School of:

Offerings above the level of approved programs must be approved in advance by the Provost.

Date
Signature of Provost (if above level of approved programs)

ALL SIGNATURES MUST BE OBTAINED PRIOR TO SUBMISSION TO THE GOVERNANCE OFFICE

Date
Signature, Chair
Faculty Senate Review Committee: ___Curriculum Review ___GAAC

___Core Review ___SADAC

ADDITIONAL SIGNATURES: (As needed for cross-listing and/or stacking)

Date
Signature, Chair, Program/Department of:

Date
Signature, Chair, College/School Curriculum Council for:

Date
Signature, Dean, College/School of:

ATTACH COMPLETE SYLLABUS (as part of this application). This list is online at:
http://www.uaf.edu/uafgov/faculty-senate/curriculum/course-degree-procedures-/uaf-syllabus-requirements/

A. CS 482 - Simulations in Computer Graphics

Meeting: 11:30-1pm TR Room 208 Gruening Building University of Alaska Fairbanks	3.0 Credits, Spring 2015 Prerequisites: CS 381 (or substantial OpenGL) Physics 212 (or equivalent calculus-based physics)	Instructor: Dr. Orion Lawlor lawlor@alaska.edu, 474-7678 Office: 201E Chapman Hours: 2-3pm TR (or open door!)
Course Website: Homeworks, Lecture Notes, Code Samples http://www.cs.uaf.edu/2015/spring/cs482 No required textbook, but you must have access to the web and a good graphics machine with WebGL.		ADA Compliance: I will work with the Office of Disability Services (208 Whitaker Bldg., 474-5655) to provide reasonable accommodation to students with disabilities.

Catalog Description

Software to simulate physical phenomena for use in interactive visualization, such as particle systems, Navier-Stokes fluid dynamics, and finite element solid mechanics. Includes Lagrangian and Eulerian meshes, stability, and discretization order. Our focus is high performance qualitatively correct simulations, rather than high-precision solutions. *Prerequisites: CS 381 and PHYS 212.*

Course Goals, Learning Objectives, and Requirements

By the end of the course, you will be able to build and understand simple simulators for a variety of physical phenomena, including moving fluids and solids. Along the way, you will learn how to use both moving Lagrangian and non-moving Eulerian meshes, how to discretize partial differential equations in space and time, how to keep your simulations from "blowing up" (computational stability) and how to apply that knowledge in a variety of domains. Simple graphics programming including GLSL shaders (from CS 381), basic Newtonian physics (from Physics 212), and good familiarity with calculus are all required. Course meetings are mostly lecture, discussion, and some in-class computer programming work; you'll do the course homeworks and projects on your own.

Student Learning Outcomes

Students completing this course will be able to:

- Choose relevant physical fields to simulate a given phenomenon.
- Discretize a partial differential equation for simulation on a 2D grid.
- Explain the difference between a structured 2D grid and an unstructured finite element mesh.

Student Resources

Academic Help: Google, Rasmuson Library, Academic Advising Center (509 Gruening, 474-6396), Math Lab (Chapman Room 305), English Writing Center (801 Gruening Bldg, 474-5314).

Grading

You'll get better grades by attending class, diligently doing the homework, and understanding the material than by cramming before the exam. Your overall grade comes from:

1. **HW:** Homeworks and machine problems, to be distributed through the semester.
2. **PROJ:** two substantial graphics projects, together with a short presentation of your results. Example projects: read a paper and implement a similar technique, implement a known physics simulation, apply an existing simulator or method to a new domain, or improve the performance of a slow simulator.
3. **MT:** Midterm Exam.
4. **FINAL:** Final Exam (comprehensive).

The final score is then calculated as:
TOTAL = 20% HW + 30% PROJ + 25% MT + 25% FINAL
This percentage score is transformed into a plus-minus letter grade via these cutoffs: A >= 93%; A- 90%; B+ 87%; B 83%; B- 80%; C+ 77%; C 70%; D+ 67%; D 63%; D- 60%; F < 60%. The grades "C-", "F+", and "F-" will not be given. "A+" is reserved for truly extraordinary work.

Grading Rubric

	A	C	F
Homework	Well-documented, polished, easy to use code that exceeds requirements.	Code that manages to meet the requirements.	Code that does not compile or does not solve the problem.
Projects	Full featured, well-rounded, and good looking code and documentation.	Project deliverables meet requirements (barely).	Project deliverables that don't exist, don't work, or are incorrect.
Exam	Clear, correct, concise explanations.	Generally correct answers.	Incorrect answers.

Course Rules

Individual assignments and tests may (rarely) be curved. Homeworks are normally due at midnight on the day they are due. Late homeworks will receive no credit. At my discretion, I may allow late assignments without penalty when due to circumstances beyond your control. Everything you turn in must be your own work--violations of the Student Code of Conduct will result in a minimum penalty equal to THAT ENTIRE SECTION OF YOUR GRADE (e.g., one plagiarized homework question will negate an otherwise perfect grade on all homeworks). However, even substantial reuse of other people's work is fine (and not plagiarism) if and only if it is clearly cited; you'll be graded on what you've added to others' work. Group projects (NOT homeworks) are acceptable if you clearly label who did what work; but I do expect a two-person group project to represent twice as much work as a one-person project. Department policy does not allow tests to be taken early; but in extraordinary circumstances by prior arrangement may be taken late.

Calendar

Last day to drop: TBD.

Project 1 presentations: Tuesday, February 24.

Midterm exam: Thursday, February 26.

Spring break: March 16-20.

Last day to withdraw: TBD.

Project 2 presentations and last day of class: Thursday, April 30.

Final exam: TBD.

Course Outline (Tentative)

Date	*Subject*	*Topics Covered*	*Homework*
1/15	Intro	Introduction to JavaScript, WebGL	HW0: OpenGL
1/20	Particles	OpenGL framebuffer and vertex buffer objects in THREE.js.	
1/22		Geometry in THREE.js and PixAnvil	HW1: WebGL and THREE.js
1/27	Forces	Newton's laws, and gravity, friction, user interface imposed forces. Stability.	
1/29		Discretizing partial differential equations, time integration via Euler or Leapfrog, discretization error.	HW2: Particle systems stability
2/3	Boundaries	Boundary conditions: bounding particles with planes, spheres, cylinders. Penalty forces & position constraint.	Project 1 Topic due
2/5		Real world application: online motion control algorithms for robotics	
2/10	FEM	Springs, chains, rope, and cloth	HW3: Spring systems
2/12		Volumetric tetrahedra, inversion, body forces	
2/17	Models	Mesh and 3D model formats	HW4: Build, ingest, and simulate a 3D model
2/19		Real world application: Failure & fracture simulations	
		Midterm exam: Thursday, February 26	Project 1 Presentations: Tuesday, February 24
3/3	GPU	Graphics card shaders, texturing, GLSL shaders	
3/5		General purpose computing on graphics processing units (GPGPU)	HW5: Shader-based GPGPU
3/10	Waves	Shallow-Water Wave Equation	Project 2 Topic due
3/12		Boundary condition images / geometry, warped grids	HW6: Wave reflections
		Spring break March 16-20	
3/24	Discretization 2D	Continuous to discrete transformation in 2D	
3/26		Courant stability limit (the speed of sound)	
3/31	PDE 2D	Reaction-Diffusion Equations, Turk/Turing	HW7: 2D PDEs
4/2		2D fluid simulation: Navier-Stokes PDE	
4/7	Fluids	Advection, Stam's Stable Fluid technique	
4/14		Multigrid and scalable Poisson solvers	HW8: Fluid flow
4/16		Rate of convergence and stability	
4/21	Applications	Real world application: heat transport in buildings, convective cooling	
4/23		Real world application: control via simulation	
4/28		Course recap and review for final exam	Project 2 Presentations: Thursday, April 30
		Final Exam: TBD 5/5 – 5/8	